

Project Investigator:

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Project Progress

The search for other forms of life motivates many aspects of the NASA Astrobiology program, including efforts to define life, to identify habitable planets, to understand the conditions conducive to the evolution of life, and to understand how life evolved on Earth. An idea that has not received serious consideration is the possibility that another life form might exist here on Earth. Carol Cleland and I have been exploring the possibility of a “shadow biosphere” consisting of microbes that are not descended from the last common ancestor of life as we know it and that do not use the same biochemical structures and strategies to support metabolism, growth, and reproduction. Although we have no evidence that a shadow biosphere exists, it must be recognized that we do not have the tools to detect it. We cannot culture 99.9% of the microbes in environmental samples; thus, there are many organisms about which we know nothing. Furthermore, molecular techniques such as rDNA amplification can only detect organisms that contain DNA as we know it. There are many examples in biology of convergent evolution – enzymes with the same function have arisen from different progenitors, and the eyes of insects and mammals originated independently. There are many solutions to any biological problem, and it is unlikely that the solutions reached by life as we know it are unique. Thus, it is possible that another form of microbial life emerged in parallel to life as we know it. This possibility warrants attention from NASA because Earth is not only clearly suitable for the evolution of life, but it is much more accessible than Mars, Europa, or extra-solar planets.

An additional effort related to astrobiology will begin in June. I will be spending five weeks at the Santa Fe Institute collaborating with Dr. Harold Morowitz. We will be searching for mechanisms by which the very slow reactions required to produce the building blocks of macromolecules might have been catalyzed under pre-biotic conditions.

Highlights

- The possibility that a shadow biosphere consisting of microbial life unlike life as we know exists and is not detectable with currently available technologies should not be dismissed.

- A new collaboration with Dr. Harold Morowitz to explore the origins of metabolism under pre-biotic conditions will begin in June 2004.

Roadmap Objectives

- **Objective No. 3.2:** Origins and evolution of functional biomolecules
- **Objective No. 4.2:** Foundations of complex life
- **Objective No. 5.1:** Environment-dependent, molecular evolution in microorganisms

Mission Involvement

<i>Mission Class*</i>	<i>Mission Name (for class 1 or 2) OR Concept (for class 3)</i>	<i>Type of Involvement**</i>
3	life definition	Co-Investigator

* Mission Class: Select 1 of 3 Mission Class types below to classify your project:

1. Now flying OR Funded & in development (e.g., Mars Odyssey, MER 2003, Kepler)
2. Named mission under study / in development, but not yet funded (e.g., TPF, Mars Lander 2009)
3. Long-lead future mission / societal issues (e.g., far-future Mars or Europa, biomarkers, life definition)

** Type of Involvement = Role / Relationship with Mission

Specify one (or more) of the following: PI, Co-I, Science Team member, planning support, data analysis, background research, instrument/payload development, research or analysis techniques, other (specify).